

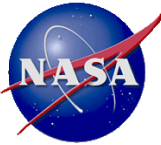
# **Information Technology Infrastructure Committee (ITIC)**

*Report to the NAC*

**November 29, 2012**

**Larry Smarr**  
**Chair ITIC**

# ITIC Committee Members



## Membership

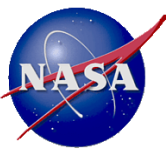
- *Dr. Larry Smarr (Chair), Director- California Institute of Telecommunications and Information Technology, UC San Diego*
- *Dr. Charles Holmes (Vice-Chair), Retired- NASA HQ Heliophysics Program*
- *Mr. Alan Paller, Research Director- SANS Institute*
- *Dr. Robert Grossman, Professor- University of Chicago*
- *Dr. Alexander Szalay, Professor- Johns Hopkins University*
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## **New Members**

- *Dr. Mark Boster; President-ImpaQ Solutions, LLC*
- *Hon. Mark Forman, former associate director of IT and e-government, OMB*
- *Mr. Joel Mambretti, Director, Intl. Center for Advanced Internet Research, NW Univ.*
- *Dr. Ed Lazowska, Gates Professor & Chair , Dept of Computer Science, UWash*
- *Dr. Pete Beckman, Dir., Exascale Technology and Computing Institute, Argonne NL*
- *Mr. John Muratore, former NASA engineer & Program Manager, now with Space X*
- *Mr. Jason Gillis (Exec Sec), Special Assist. to CIO, NASA*

# ITIC Committee Briefing Topics

## NON-FACA, Morning Session at Marshall SFC



### ◆ **Welcome and Introduction to MSFC**

- Patrick Scheuermann; Center Director
- Jonathan Pettus; MSFC CIO
- Sharon Cobb; SLS

### ◆ **Chandra Astronomy Mission**

- Martin Weisskopf

### ◆ **SPoRT**

- Gary Jedlovec

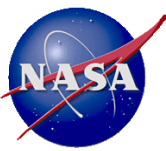
### ◆ **MSFC Office of the CIO**

- Jonathan Pettus - Overview
- Carol Bryant - High Performance Networking
- Jane Maples – Mobile Applications

### ◆ **Human Space Flight Operations At MSFC**

- Jay Onken

# ITIC Finding #1 Mar. 2012



◆ **To enable new scientific discoveries, in a fiscally constrained environment, NASA must develop more productive IT infrastructure through “frugal innovation” and “agile development”**

- Easy to use as “flickr”
- Elastic to demand
- Continuous improvement
- More capacity for fixed investment
- Adaptable to changing requirements of multiple missions
- Built-in security that doesn’t hinder deployment

**Two Good Examples  
From NAC ITIC Fact-Finding Trip  
to Marshall Space Flight Center**

**Presented to NAC March 2012**

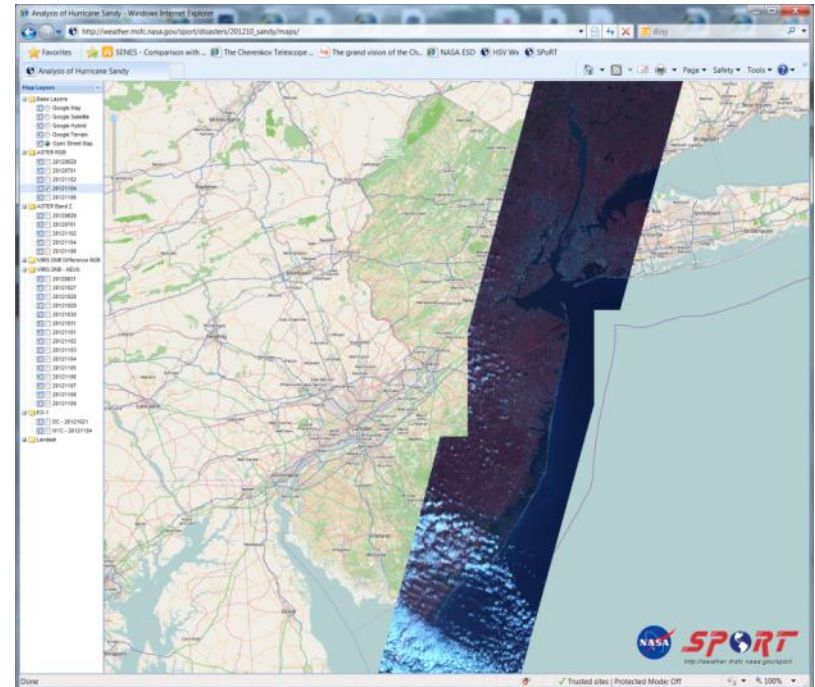
# Web Services to Support Disaster Applications

Short-term Prediction Research and Transition Center

Need for access to data and products supporting disaster applications “anytime and from any place”

## SPoRT Web Services

- tiled imagery for a “Google Earth” roam and zoom
- web-based applications - [tiled web service link](#)
- Android and iPhone “apps”

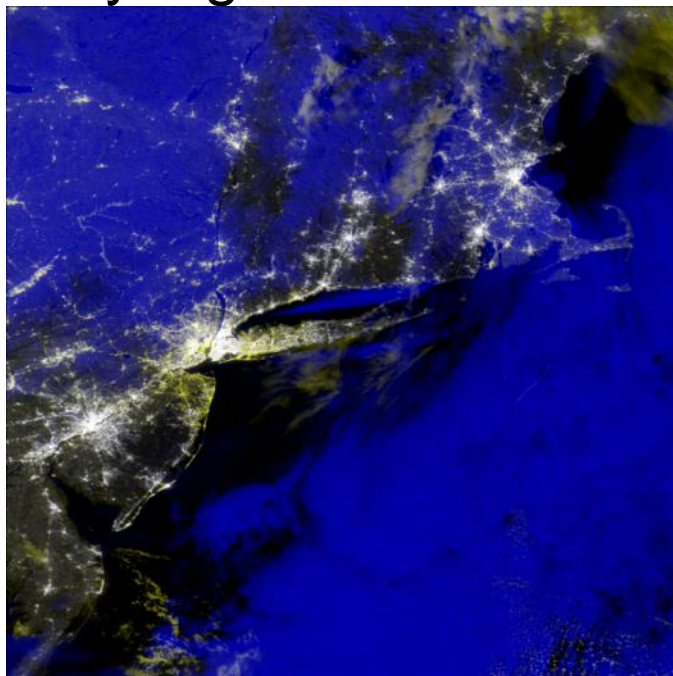


Tiled web service for Hurricane Sandy

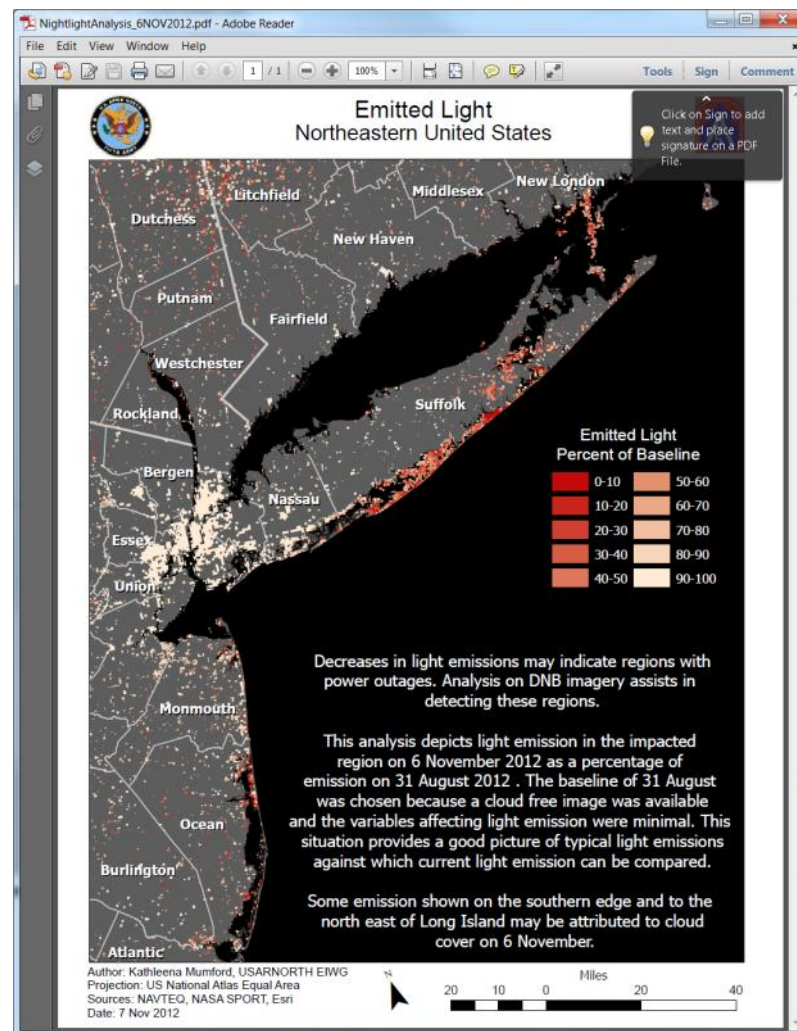
# VIIRS DNB Detects Power Outages



City Lights – 8-31-2012  
City Lights – 11-04-2012



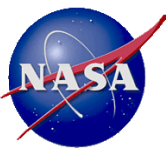
RGB composite image indicating extent  
of area affected by power outage  
(yellow)



U.S. Army North Command uses SPoRT  
products to monitor power recovery



transitioning research data to the operational weather community



# **SPoRT Success Due (In Part) to Access to Advanced Information Technology**

**External high performance computer systems allow for model development, benchmarking, and case study analysis and frees up local resources**

**Local high performance systems allow special configurations of regional models to be provided in a timely fashion to end users**

**Web services support dissemination of data to a broad user community**

**Cloud computing resources provide configurable assets for regular or infrequent applications**

**Hyperwall capabilities allow for advanced product training and real-time disaster support**

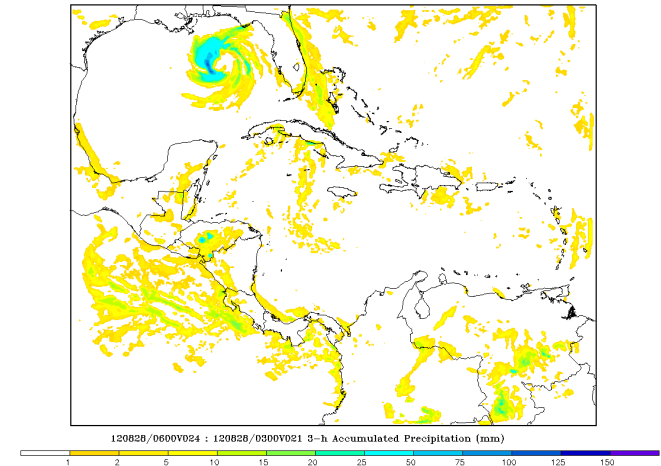


**transitioning research data to the operational weather community**

# Code I Private Cloud

SPoRT uses “cloud” computing resources to support ongoing and specific partnering projects

- configurable “images” in NASA Code I Private Cloud and at Amazon
- regular execution of pre-configured weather model runs requiring unique resources - SERVIR Mesoamerica forecasts



6hr precipitation forecast for SERVIR (Hurricane Isaac)

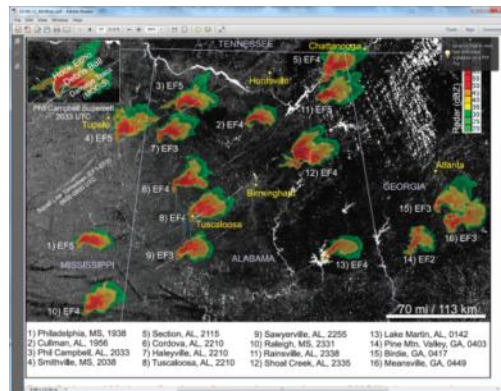


Image processing for tornado damage tracks

- pre-configurations for infrequent applications in support of disaster applications - used during MSFC 10 day power outage from April 27, 2011 tornado outbreak [ASTER link](#)

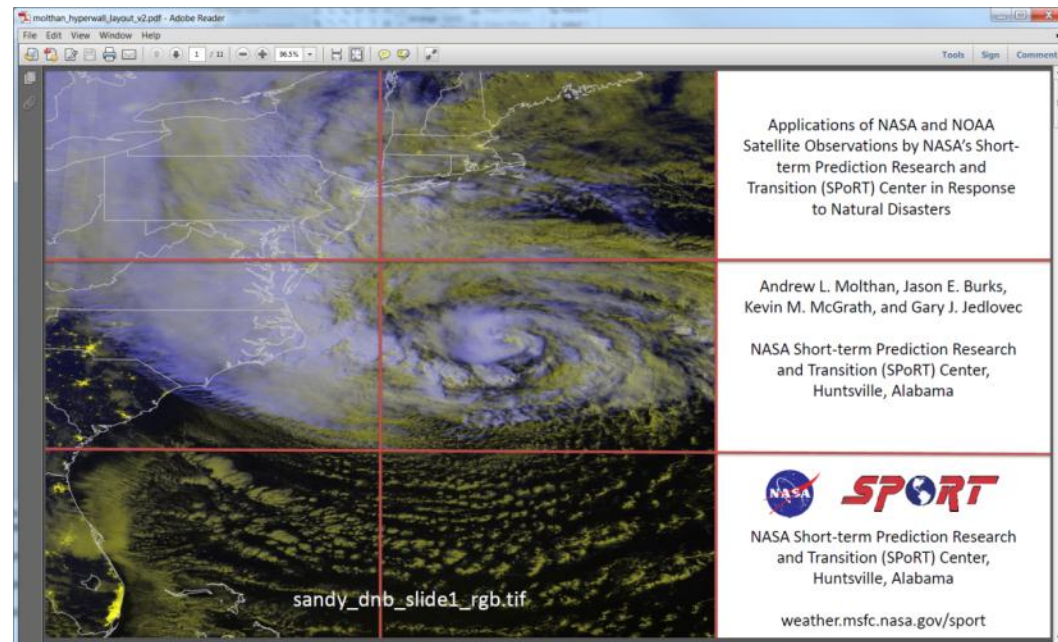
# SPoRT

## Visualization and Collaboration Lab

Lab under development, will host a large hyperwall display

- visualization for demonstrations showing scientific results
- scientific discovery through interactive analysis and display
- end user training and development workshops
- disaster response and support

*Hyperwall display at NASA Center for Climate Simulation (NCCS)*



# A NASA-Wide Mobile Apps Project

[apps.nasa.gov](http://apps.nasa.gov)



**apps@NASA** is...

A website where NASA employees & contractors can download mobile apps that access NASA systems. These apps enable users to perform critical job functions at any time from anywhere, via Personal *AND* NASA mobile devices.



Jane Maples

Contact us at: [msfc-cima@mail.nasa.gov](mailto:msfc-cima@mail.nasa.gov)

## ◆ Software Library

- Framework Libraries
- Example applications

## ◆ Documentation Library

- Getting started documents
- Development standards
- Technical instructions
- Coding How-To's

## ◆ Instruction Videos

- Getting started videos

## ◆ Development Forums

- Development discussions

## Downloads

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### **iOS Framework 1.0**

Developer library for iOS devices. It enables apps to use CIMA hosting, monitoring and deployment solutions.



### **Android Framework 1.0**

Developer library and an example application for Android devices. It enables apps to use CIMA hosting, monitoring and deployment solutions.



### **iOS Example Application**

iOS application showing how to use CIMA services.



### **Hybrid Plugin Example Application**

Hybrid plugin example application description goes here.



### **Hybrid Pulse Example Application**

Hybrid pulse example application description goes here.



### **Hybrid Example Application**

Hybrid example application description goes here.

Jane Maples

Contact us at: [msfc-cima@mail.nasa.gov](mailto:msfc-cima@mail.nasa.gov)

# Critical AppStore success factors



- ◆ **Executive Sponsorship**
- ◆ **Clearly Defined AppStore Scope**
  - What apps are to be hosted (internal, external, COTS, GOTS)?
  - Who are the users (govt employees, contractors, public)?
  - What are the Rules of Engagement for hosting?
- ◆ **Coordination with IT Security and Identity, Credential, and Access Management teams**
- ◆ **Scalable Infrastructure**
- ◆ **Agile architecture to quickly support existing and emerging mobile platforms (i.e., iOS, BlackBerry, Android, MS, etc.)**
- ◆ **Marketing and Communication Strategy**
- ◆ **Dedicated team (manager, developers, customer relationship manager, graphics designer)**
- ◆ **Pilot group of mobile users for initial rollout and future enhancements**

Jane Maples

Contact us at: [msfc-cima@mail.nasa.gov](mailto:msfc-cima@mail.nasa.gov)



# **NASA OCIO Support for High Performance Networking**

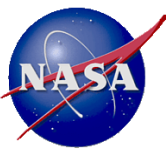
**November 28, 2012 Briefing  
for the**

**NASA Advisory Council (NAC)**

**Information Technology Infrastructure Committee (ITIC)**



# Current CSO WAN Backbone



## Regional Sites:

Dual, diverse connectivity to:

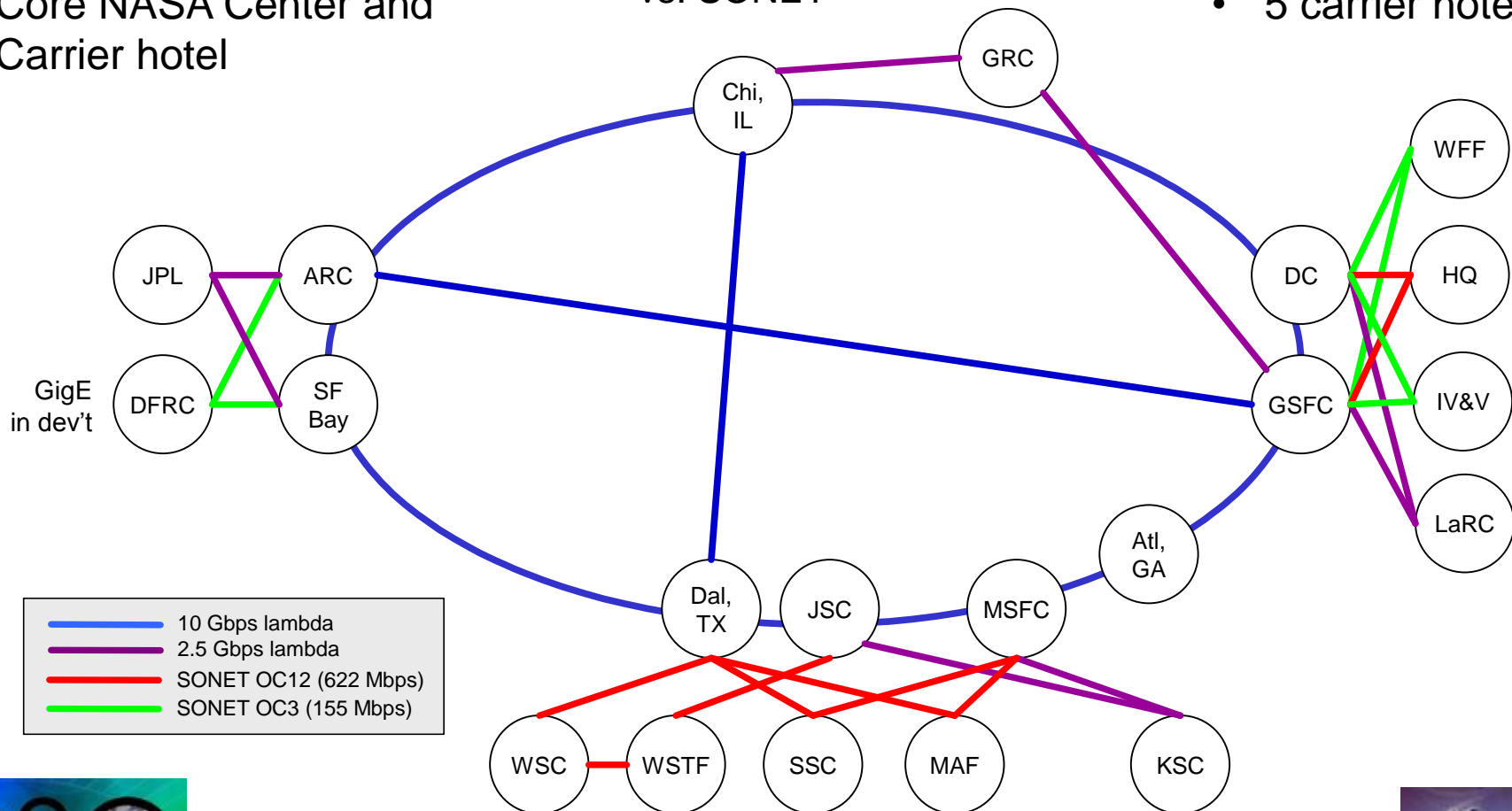
- Core NASA Center and
- Carrier hotel

50 ms failover:

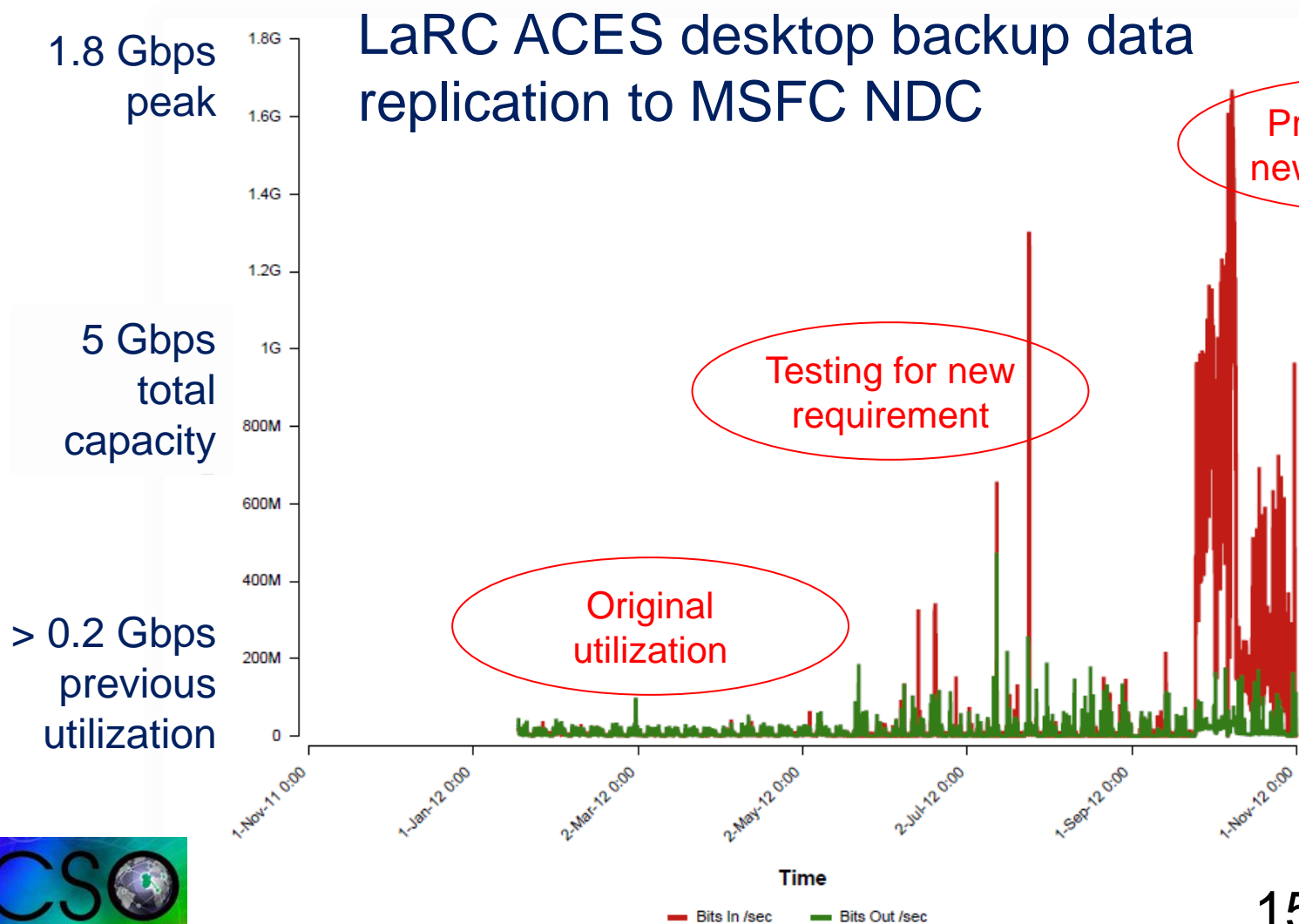
Fast ReRoute (FRR)  
vs. SONET

## Core Sites:

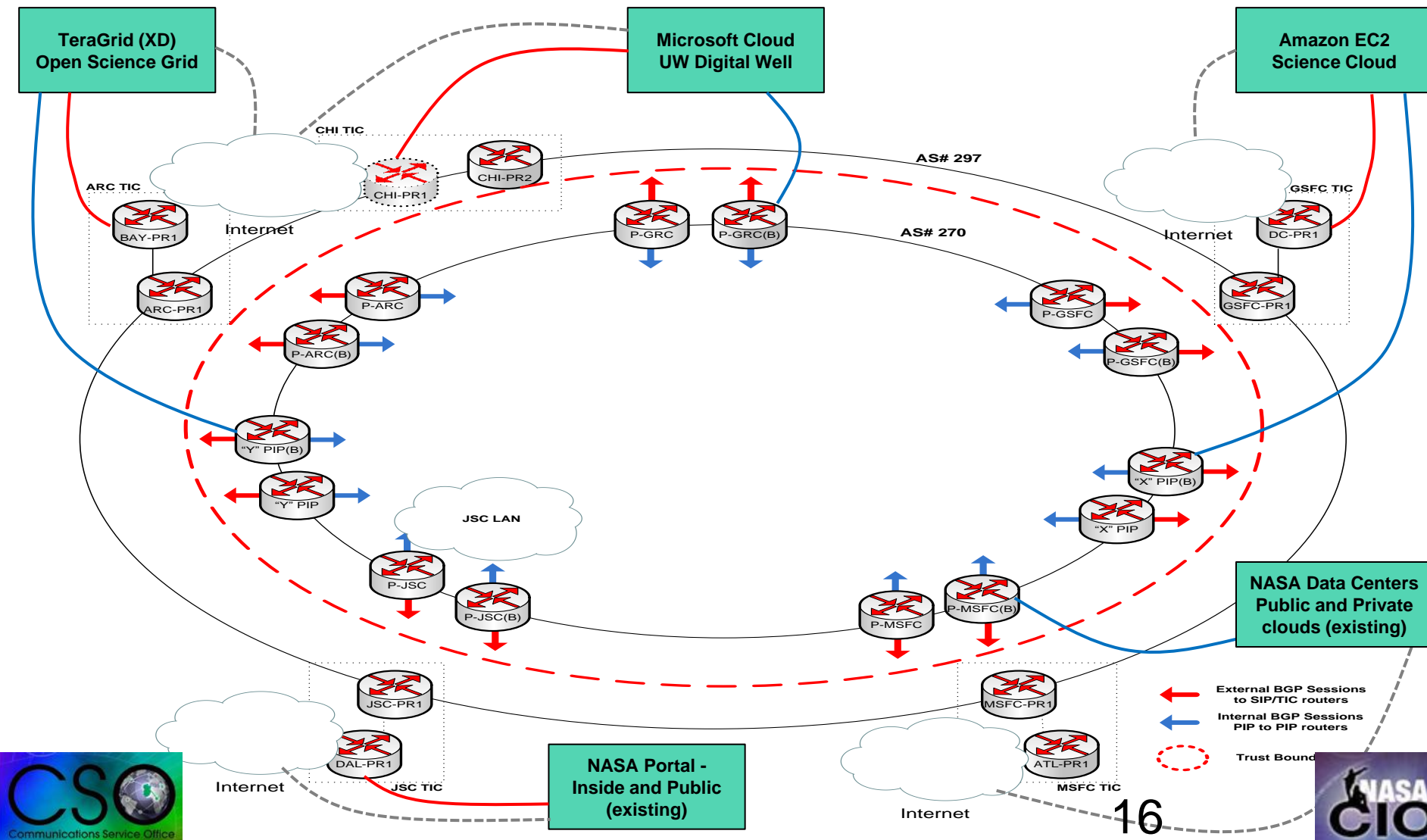
- 4 NASA Centers
- 5 carrier hotels



# Example: Accelerated Implementation of Requirements

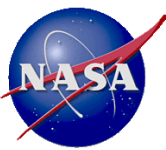


# Incorporate Commercial Cloud Services



# NAC Committee on IT Infrastructure

## Recommendation #1 Mar. 2012



◆ **Recommendation:** To enable NASA to gain experience on emerging leading-edge IT technologies such as:

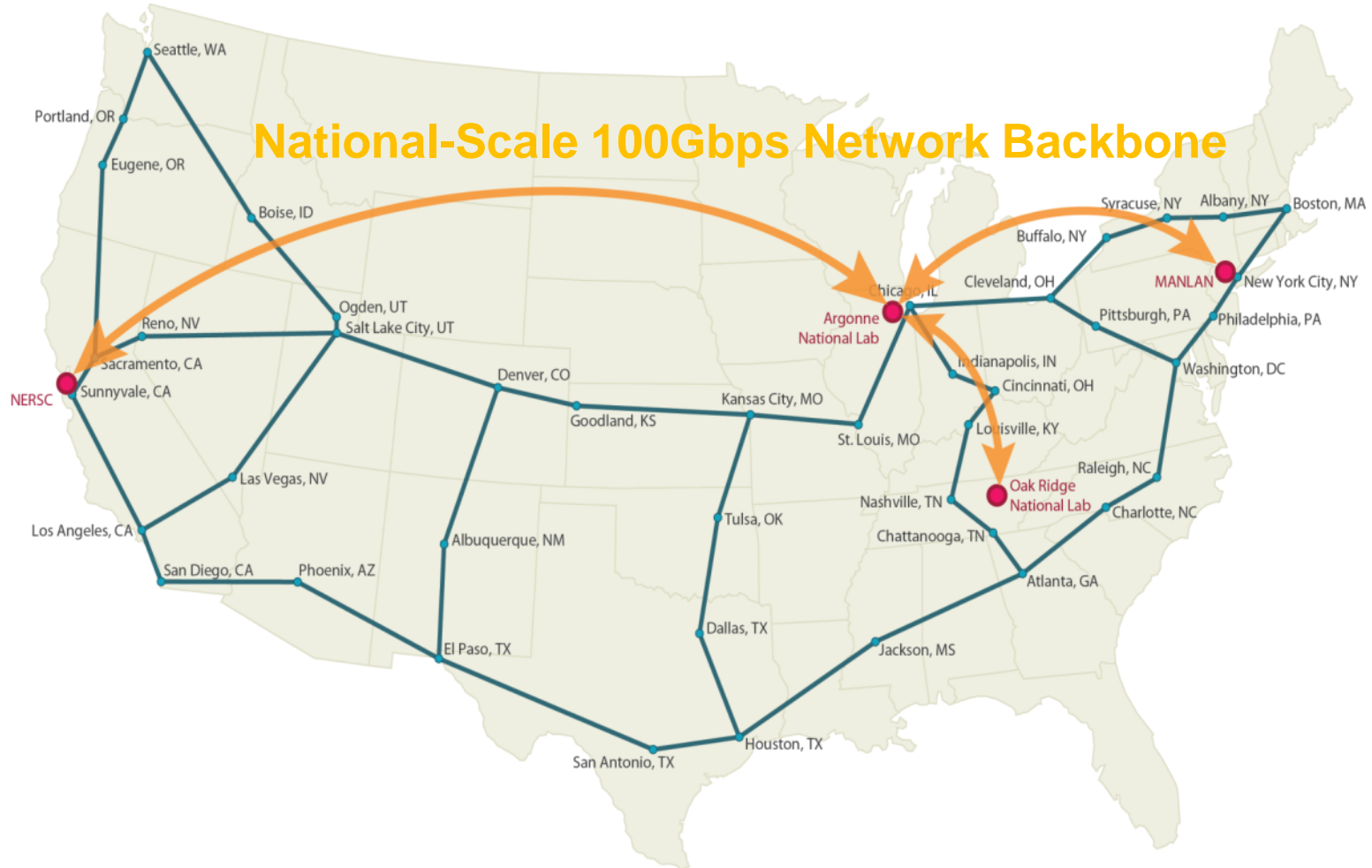
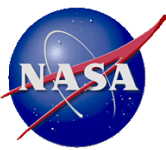
- *Data-Intensive Cyberinfrastructure,*
- *100 Gbps Networking,*
- *GPU Clusters, and*
- *Hybrid HPC Architectures,*

we recommend that NASA aggressively pursue partnerships with other Federal agencies, specifically NSF and DOE, as well as public/private opportunities.

We believe joint agency program calls for end users to develop innovative applications will help keep NASA at the leading edge of capabilities and enable training of NASA staff to support NASA researchers as these technologies become mainstream.

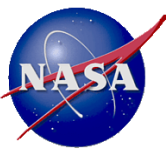
Adopted by NAC March 2012

# Partnering Opportunities with DOE: ARRA Stimulus Investment for DOE ESnet



Source: Presentation to DOE ESnet Policy Board

# 100 Gbps Consortium for Petascale Science



- ◆ **NASA Goddard**
- ◆ **International Center for Advanced Internet Research at NW Univ.**
- ◆ **Mid-Atlantic Crossroads**
- ◆ **Laboratory for Advanced Computing at the Univ. Chicago**
- ◆ **Johns Hopkins University**
- ◆ **Naval Research Laboratory**
- ◆ **StarLight Communications Exchange Facility**
- ◆ **Metropolitan Research and Education Network**

Consortium support comes from:

DOE's ESnet Advanced Network Initiative, Ciena, and Sidera Networks

Other key demonstration partners are:

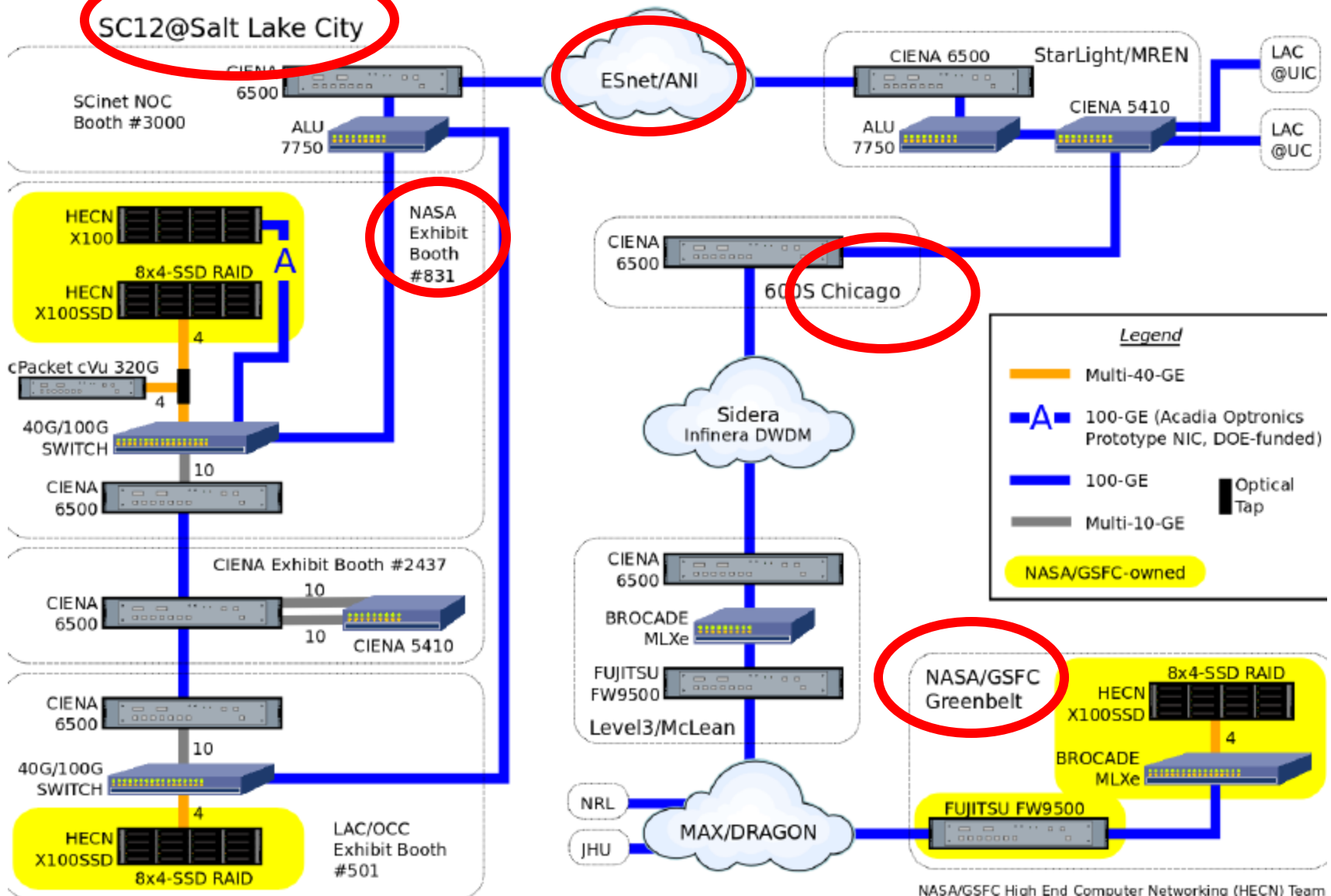
SCinet, NLR, Internet2, Brocade, Fujitsu, cPacket, Arista, and Force10

Update to ITIC NAC Report Aug 2012

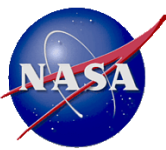


# Evaluations/Demonstrations of 100 Gbps IPv4/IPv6 Disk-to-Disk File Transfer Performance Across LANs & WANs

An SC12 Collaborative Initiative Among NASA and Several Partners



NASA/GSFC High End Computer Networking (HECN) Team  
Diagram by Bill Fink / Paul Lang - 9/18/2012



**98.4 Gbps sustained  
Across the Country!  
Essentially 100x Large  
Flows on Shared COS**



Supercomputing 2012 Salt Lake City, UT

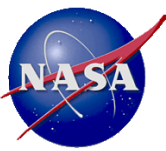


**NASA's High Performance  
Network Innovators:  
Bill Fink, Paul Lang,  
and HECN Team**

**High End Computer  
Networking (HECN)  
Science and Exploration  
Directorate, GSFC**

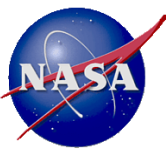
<http://science.gsfc.nasa.gov/606.1/HECN.html>

# ITIC Finding #1 Nov. 2012



- ◆ While the CSO appears to be doing an amazing job managing the communications requirements and responsibilities for the agency, it may be time for them to develop the business case for acquiring dedicated fiber-optic pathways in support current and future high data-volume traffic: e.g. interfacing to NASA's supercomputers.

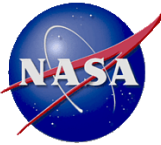
# ITIC Finding #2 Nov. 2012



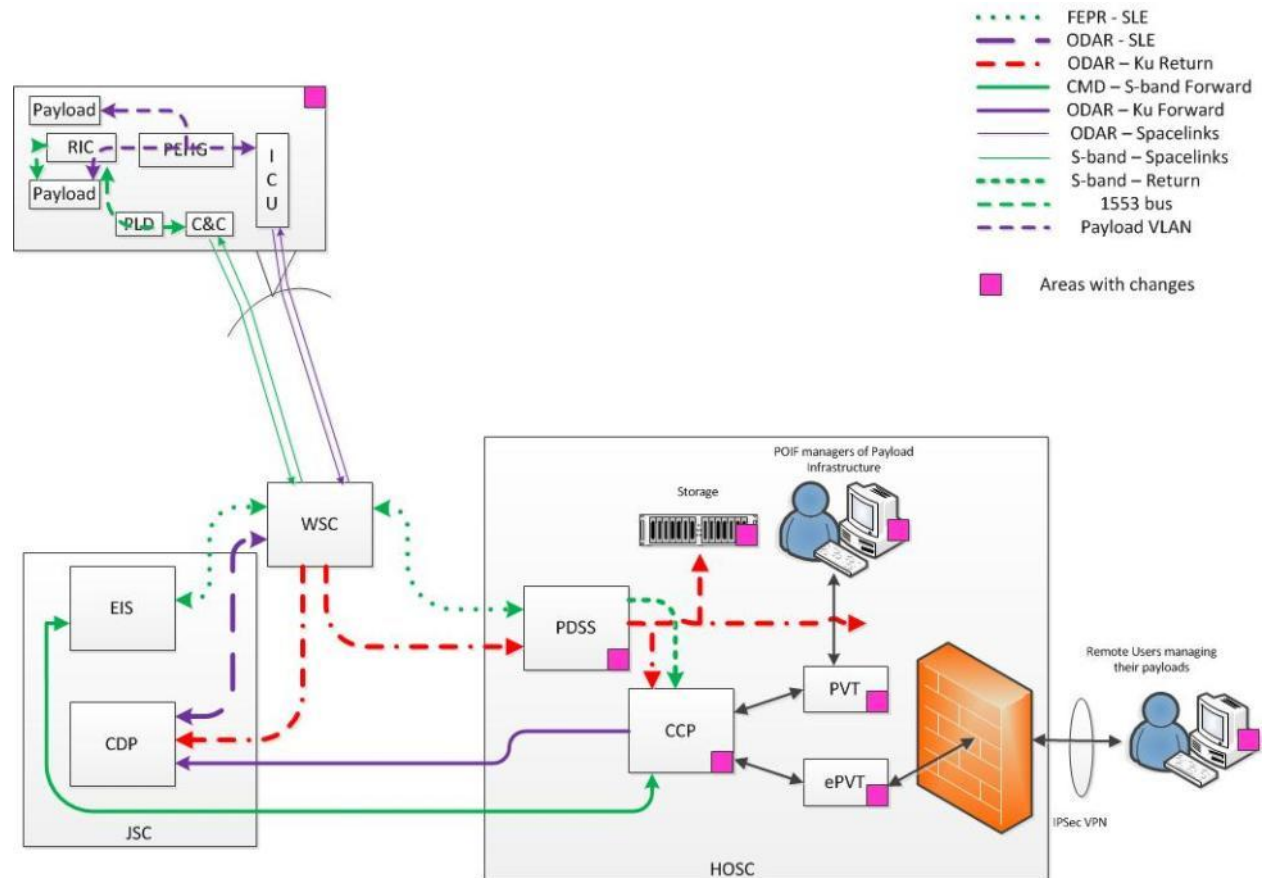
- ◆ The ITIC is encouraged by the multi-center collaborations involved in engineering activities to upgrade Marshall's Huntsville Operations Support Center (HOSC) and Payload Operations and Integration Center (POIC).
- ◆ Not only with the traditional Human spaceflight centers such as JSC and KSC, but also engineering expertise and tools from GSFC, ARC, JPL, etc, are being incorporated into this activity.



# Internet Connectivity to ISS



- IP Encapsulation expands the use of standard internet protocols to access ISS resources beyond file transfer
- Puts user at payload experiment
- Control Center monitors user traffic; does not allow unsecure protocols nor unauthorized access

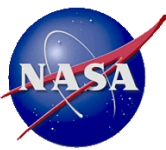


# 3D HDTV Camera on ISS

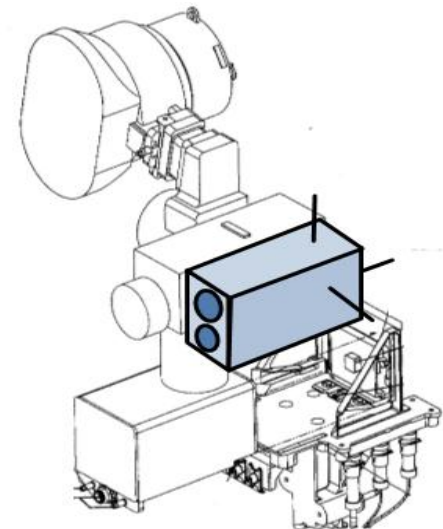
- ◆ **Joint project with Panasonic to demonstrate functionality and usefulness of all-in-one 3D HDTV camera**
  - Cameras for flight and training provided at no cost by Panasonic
- ◆ **Panasonic 3DA1 3D HDTV camera was carried to the ISS on STS-135 and returned on SpaceX-1**
  - Proved all-in-one stereoscopic camera can provide useful 3D HDTV video
  - First experience with file based video workflow
  - After 19 months on orbit there were no visible pixel defects
    - Currently analyzing camera to determine actual number of dead pixels
    - Dead pixels masked by in-camera pixel correction algorithm



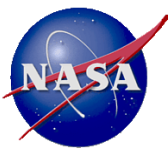
# External HDTV Camera Project



- ◆ Recently approved by NASA International Space Station Program Manager
- ◆ Attach a HDTV camera to the side of existing ISS external analog camera housings
  - Saves having to develop a new pan & tilt system
  - Use external **wireless communication system** for camera control and video transmission
- ◆ Minimum requirements
  - Will include Zoom lens
  - 1280 x 720 progressive @ 60 frames-per-seco
  - H.264 video encoding
  - Use commercial-off-the-shelf cameras
    - Camera selection process is underway
    - May use more than one commercial camera

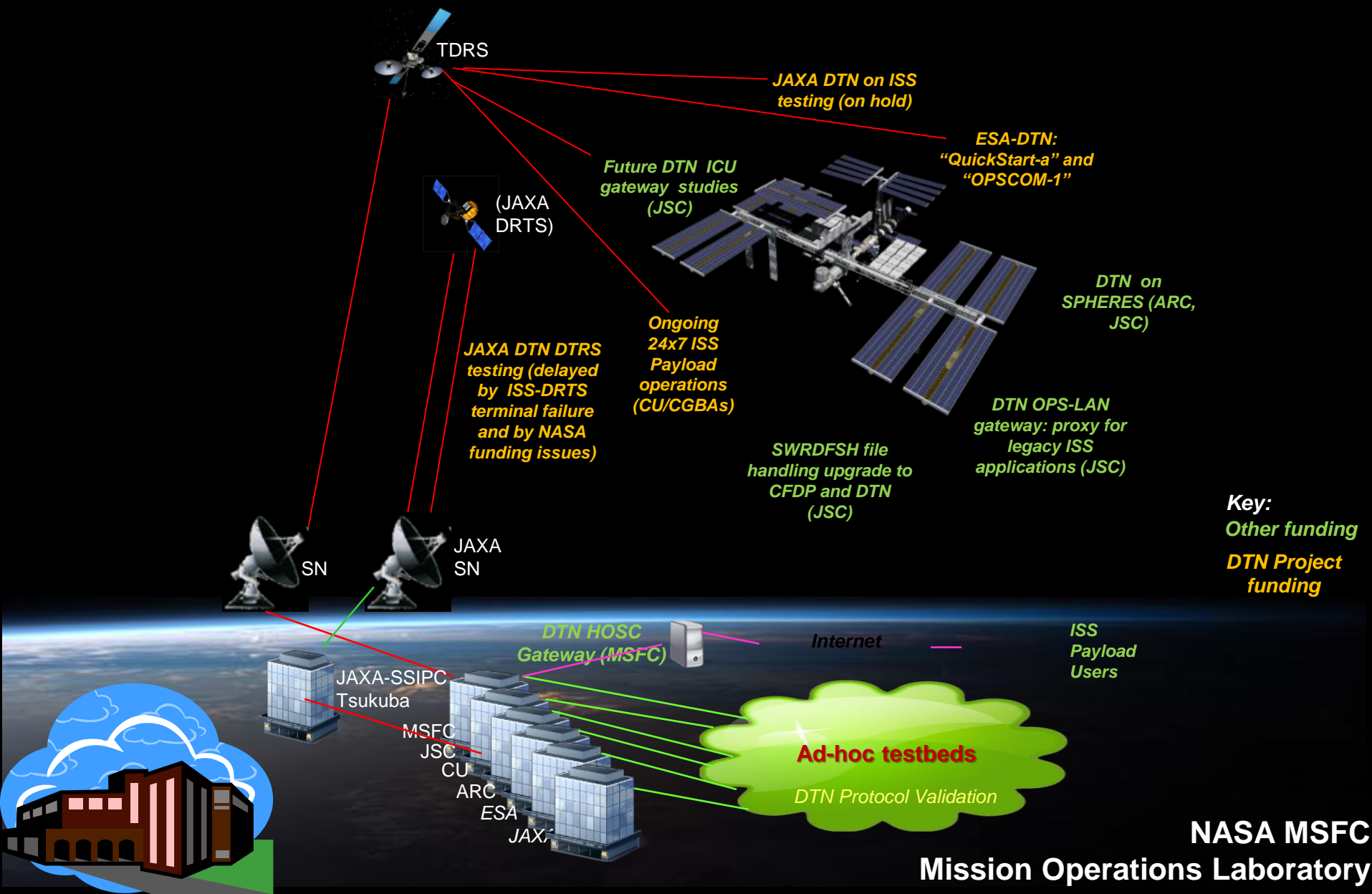


# Disruption Tolerant Networking (DTN)



- ◆ **DTN “adapts” Internet Protocols for in-space application**
  - Store-and-forward improves automation, throughput, latency
  - For LEO missions automates AOS/LOS type disruptions
  - For deep space missions, fixes the IP problems with long signal delays
- ◆ **NASA has two activities – MSFC/MOL performs in both:**
  - NASA DTN Project – under SCan at NASA HQ
  - International DTN Standards – under CCSDS, SCan/AES
- ◆ **Current ISS DTN system has three nodes**
  - Onboard ISS Bioserve payload
  - HOSC
  - CU-Boulder (Payload operations)
- ◆ **MOL developed the HOSC DTN node to support other payloads with DTN services when they request it**
- ◆ **MSFC/MOL is engaging ISS to encourage more extensive deployment of DTN onboard**

# NASA's Current ISS-based International DTN Flight Test and Demonstration Activities





# The Expressome as the “Telescope for Life Sciences”

High Content Screening: as platform for high density/high throughput life science utilization of ISS

- **Transcriptome**
  - mRNA transcription
- **Proteome**
  - Protein expression
    - Intron/exon editing
  - Protein activity control
    - Signaling
    - Phosphorolation
    - Nitrosylation
- **Metabolome**
  - Substrates, intermediates, & products for enzyme pathways
- **Epigenome**
  - Changes in DNA & histone chemistry

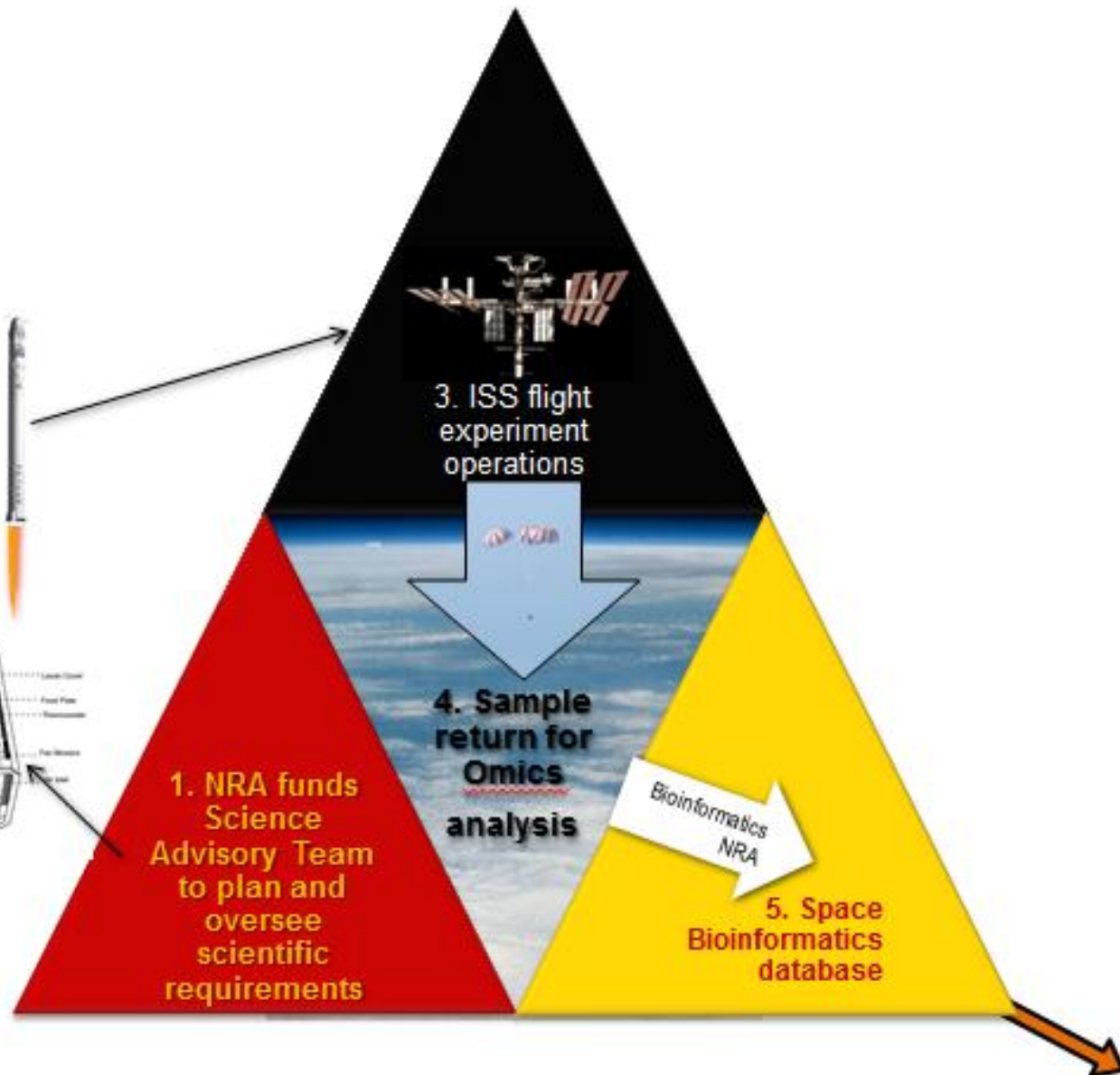
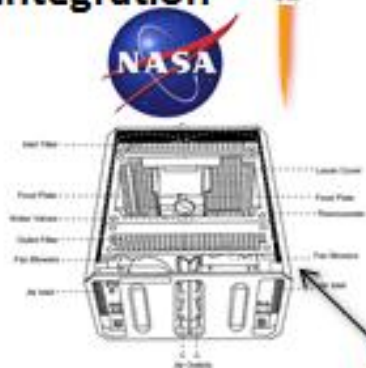
$$\begin{array}{r} \text{Transcriptome} \\ \text{Proteome} \\ \text{Metabolome} \\ + \text{Epigenome} \\ \hline = \text{Expressome} \end{array}$$

Human Exploration &  
Operations Mission  
Directorate:  
Division Director:  
D. Marshall Porterfield

# geneLAB Science Campaign Platform



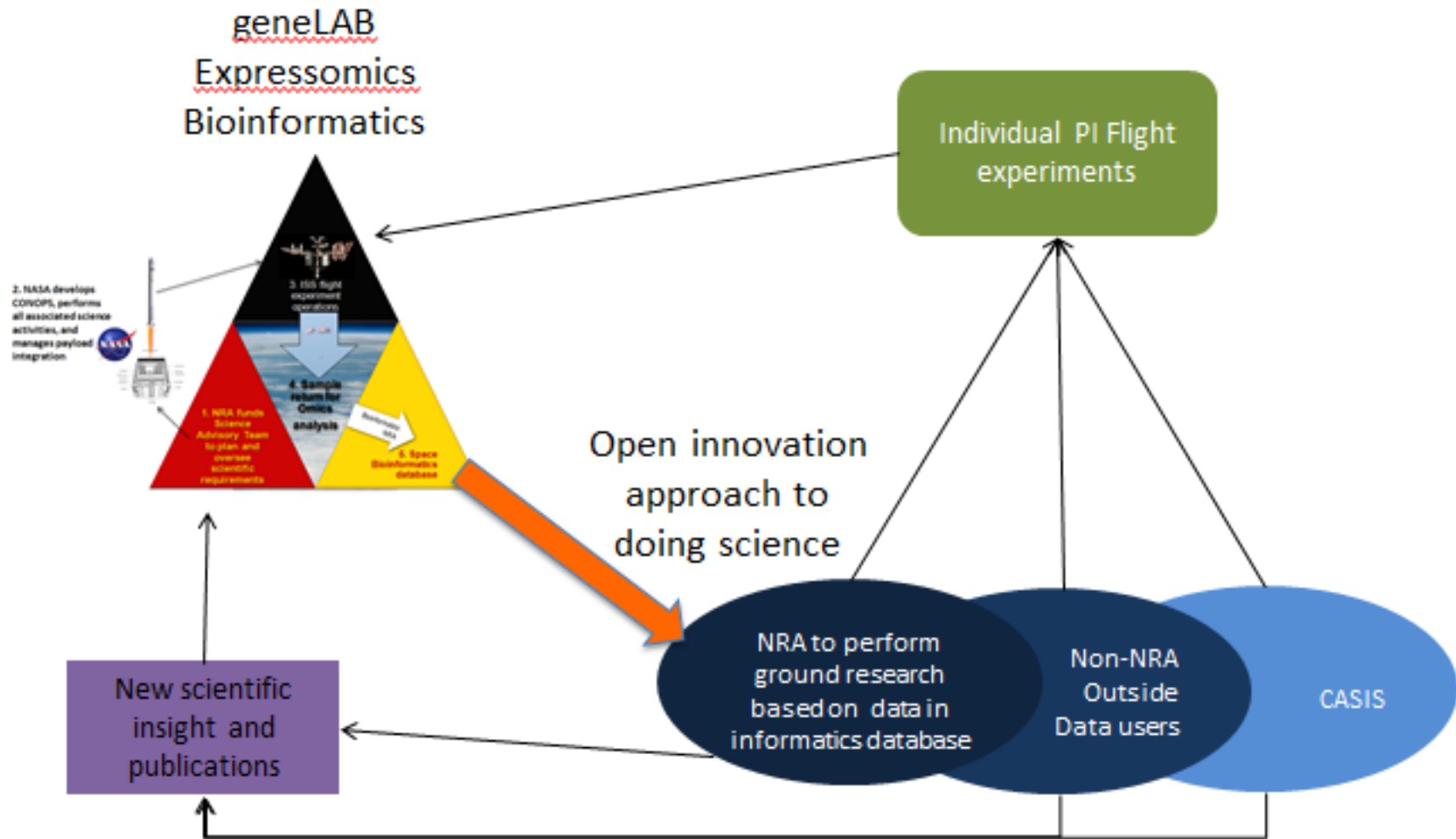
2. NASA develops CONOPS, performs all associated science activities, and manages payload integration



Human Exploration & Operations Mission Directorate  
Division Director: D. Marshall Porterfield

# geneLAB

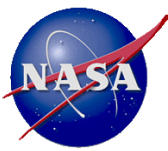
multi-investigator utilization  
open source science innovation



geneLAB RFI release soon...

Human Exploration & Operations Mission Directorate  
Division Director: D. Marshall Porterfield

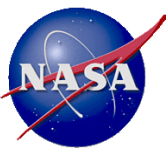
# ITIC Finding # 3 Nov. 2012



- ◆ **There are multiple opportunities for ITIC to work with the Human Exploration and Operations Committee on IT innovations within the ISS program & the HOSC/POIC upgrades**
- ◆ **Topics Could Include:**
  - Bioinformatics Infrastructure
  - Human-Robotic Information Integration
  - Advanced Media Technologies
  - Laser communications
  - Solar System Internet

# NAC Committee on IT Infrastructure

## **DRAFT\*** Recommendation #2



- ◆ **Recommendation:** NASA should formally review the existing national data cyberinfrastructure supporting access to data repositories for NASA SMD missions. A comparison with best-of-breed practices within NASA and at other Federal agencies should be made.
- ◆ We request a briefing on this review to a joint meeting of the NAC IT Infrastructure, Science, and Education committees within one year of this recommendation. The briefing should contain recommendations for a NASA data-intensive cyberinfrastructure to support science discovery by both mission teams, remote researchers, and for education and public outreach appropriate to the growth driven by current and future SMD missions.

\* To be completed after a joint meeting of ITIC, Science, and Education Committees in July 2012 and the final recommendation submitted to July 2012 NAC meeting